



Boston University
Electrical & Computer Engineering
EC463 Capstone Senior Design Project
Problem Definition and Requirements Review

IoT Kitchen

Submitted to

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by



Team #21

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Customer Sign-Off _____

IoT Kitchen

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Project Summary

Team 21 - IoT Kitchen aims to build the ultimate smart cooking assistant for amateur home chefs. IoT Kitchen provides hands free assistance following recipes as well as updating recipes to their own preferences in real time with the help of a user friendly app interface, Natural Language Processing (NLP) assistant, and several IoT sensors. These sensors will be able to track the users ingredient addition and cooking time, providing feedback to the app to update the recipe and to the NLP assistant for altering instructions. Combined, IoT Kitchen will make following along to recipe and cultivating new ones easier than ever before.

1 Need for this Project




As society progresses towards living a more health conscious lifestyle, what we feed our bodies is becoming increasingly important. There is an understanding that food not only dictates much of our physical well-being, but our mental well-being too. With this increased awareness, there is a strong need to break the barriers that prevent people from stepping into the kitchen and for a way to optimize the cooking experience.



These barriers come in various forms – be it time constraints of leading a busy lifestyle, lack of knowledge surrounding the cooking process, overwhelm from the numerous recipes available, the inability to modify and save recipes in real time, etc. People from all walks of life face these issues which highlights the massive need for a solution. This is where IoT Kitchen steps in. IoT Kitchen revolutionizes how people spend their time in the kitchen. We aim to provide the guidance and the efficiency to minimize the stated obstacles and provide a kitchen assistant that leads to an overall smarter, more personalized and more convenient cooking process.



2 Problem Statement and Deliverables

The goal for this project is to build an app with supporting IoT devices to help home chefs follow and interact with recipes easily and hands-free. Amateur home chefs often have difficulty following recipes, especially when they need to **convert units**, **scale serving sizes**, or **scroll through their device displaying the recipe**. In addition, when chefs make alterations to their recipes, such as **switching out ingredients**, using **different amounts**, or **cooking for a longer time**, it is difficult to note these changes mid-cooking for future use. IoT Kitchen aims to solve these problems by creating an interface that **takes input through voice commands** from the chef and **sensor measurements to reflect the changes that a chef makes to a recipe while leading the chef through the steps**.

The first component of IoT Kitchen is a **user friendly, cross platform app**. There will be two modes for this app, in **recipe and out of recipe**. In the in recipe mode, users can **import recipes from the internet**, **upload one from our database**, or **write their own to follow along with**. With the use of different sensors and IoT devices, the application will read out instructions for the cook and accept user alterations to the recipe, updating it in real time. The app will also have built in features to **do unit conversion** and **serving scaling for any recipe**. In the out of recipe mode, the app will be broken down into three different pages: **user profile**, **user feed**, and **recipe database**. On the user profile, cooks can make a social-media esq page featuring their cooking  interest and recipes. Users will also be able to view their own recipe history through their profile. This will include all the recipes they have uploaded or cooked through the app, with their suggestions and changes. Cooks can view the **profiles and recipes** of other users on the user feed, similar to any social media newsfeed. Finally, a stretch objective is to cultivate a recipe database within the app so that users can get inspiration and be suggested new things to cook from our list of recipes.

The other crucial deliverable for this project is a series of sensors and IoT devices. The first of these devices will be a smart assistant that processes user speech input using Natural  Language Processing. This assistant will read lines of the recipe to the cook when prompted and will send the app recipe changes if the cook voices them. Additional data will be sent to the app to update the recipe in real time through a smart scale that precisely measures ingredients. **This** scale can also communicate with the NLP assistant to tell the cook if they are measuring incorrectly. Another potential sensor is a smart oven thermometer that will notify the user when the desired temperature of the oven has been reached. Finally, a stretch goal is to design a series of smart measuring cups that will work similarly to the scale, registering user changes as well as helping the user follow the recipe. 

All of these elements will combine to be the ultimate cook's assistant, helping amateur cooks follow recipes as well as cultivate their own.

3 Visualization

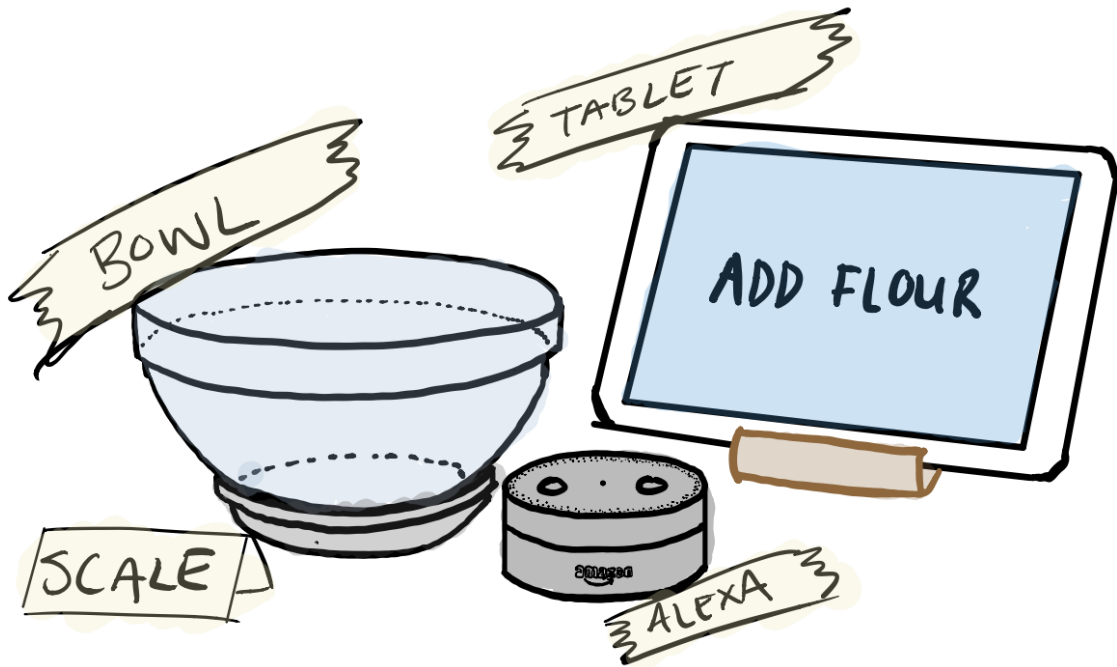


Figure 1: Hardware Components

The scale is connected and synced with the tablet via Bluetooth. The tablet will display directions for a recipe which you can add to the bowl and the scale measurements will be displayed on the tablet. If you want to make changes or control the tablet, you can command Alexa via voice command to do so.





Figure 2: Software Component

Home page will contain a newsfeed. Profile page will contain and track total dishes, calories, and time.

Recipes page will just include your recipes and recipes you can find online. Settings is to connect to voice assistants



4 Competing Technologies

Since the goal for this project is to build an app with supporting IoT devices to help home chefs follow and interact with stored recipes, we will need to look into the same sort of app on the market as competing technology. After doing some research online, we found that there are several measuring devices that have similarity with our measuring device such as Vitamix Perfect Blend Smart Scale and Range Digital Thermometer and there are also several smart cooks such as Everycook Automated Pressure Cook and Crock-Pot Wemo Smart Wifi Slow Cooker. We found out that there are some similar products on the market but there are no products that primarily focus on making salad and doing bakery with voice control and user interact recipe system incorporated.

Measuring Device on the market that will compete with our device:

Vitamix Perfect Blend Smart Scale & Recipe App: The scale is connected with app which prompt users to measure ingredients according to the recipe. The scale could also accurately measure ingredients to nearest .01 gram. This will compete with our device as we do not know the price to build a scale that has 0.01 gram precision yet, although we will most likely build a scale with precision of 1 gram.

Range Digital Thermometer: This is a wired precision food thermometer that plugs into a phone or tablet to provide temperature graphs and instant readouts. Since our version of IoT device will need to monitor the temperature and humidity within the food to ensure it is cooked properly, a wired, not embedded electronics, thermometer is required.

Everycook Automated Pressure Cook: A cooking box that incorporate slicing, measuring and cooking at the same time. Just like our product, it is designed for those who don't feel as comfortable in the kitchen. Although both products are targeting the same group of audience, our device will focus more heavily on the baking part which does not require the slicing movement and it will also facilitate the cleaning process. Our product will also update the app as we are aiming to make an app which allows users to make modifications to the recipe, upload their own version of the recipe and share their recipes online.

Crock-Pot Wemo Smart Wifi Slow Cooker: Different the pressure cook above, the slow cooker is powered by Belkin's free WeMo app, which lets users start or stop cooking, adjust temperatures and cook times, and set alerts and notifications. However, this device does not provide recipe for users to choose and home chef will need to measure the ingredients by themselves. Since our product won't be able to adjust the temperature for the oven, we will combine the set alert and the temperature graph into our app to better monitor the baking process. And user will be able to compare the temperature graph each time and adjust their recipe for the temperature and baking time in order to achieve the best result.

5 Engineering Requirements

Hardware

Functions/Objectives

- A device that acts as the HUB during cooking sessions (A phone, Amazon Alexa, Google Home, etc.)
 - Utilizes natural language processing to understand commands given by the cook vocally
 - Connects and receives data from all sensors used
 - Vocally and (depending on the device used) visually guides the cook through the recipe
 - Connects to users' profile on the app and uploads all of the data for the cooking session.
 - time of day
 - start time
 - end time
 - data from sensors
- Sensors
 - Smart scale for measuring the amount of ingredients used in the recipe.
 - Allows for zeroing
 - Measures the weight of ingredients used during a cooking session.
 - Oven thermometer
 - Measures temperature inside the oven
 - **Stretch Goal** - Smart measuring cups
 - Knows when the measuring cup is used, another way to measure the amount of ingredients used
 - Measure the weight of ingredients used in the measuring cup
- All sensors utilize Wi-Fi or Bluetooth to connect to HUB device

Split times?

1:9:10:50

↑ wireless

Metrics/Constraints

- Natural Language Processing
 - Accuracy above 90% for relevant phrases.
- Smart Scale
 - Measures up to at least 2kg
 - Precision of at least 0.01g
- Oven thermometer
 - Precision of at least 1°F
 - Measures temperatures between 250°F to 550°F
 - Withstand temperatures up to 550°F
- **Stretch Goal** - Smart measuring cups

← why?

- Measure with precision of 0.01g
- Measure up to 10g

Software

Functions/Objectives

- User friendly app
 - Runs on multiple platforms (Cross-Platform) ← Pick 1?
 - Stores data for different users utilizing a cloud service
 - Recipes
 - Cooking session data
 - Recipe used
 - Amount of ingredients used ✓
 - Oven temperature
 - Date and time of session start
 - End time
 - Displays data in an intuitive way
 - Connects and retrieves sensor data from the HUB
 - Intuitive way to add recipes
 - Allows for recipe variations (i.e. same base recipe, with an added ingredient or modified cooking time)
 - Can search for and follow other users to see their cooking recipes and activity
 - Can like and comment on recipes and cooking sessions
 - **Stretch goal** - Recipe database
 - Houses a list of recipes that can be searched through and then be added to a user's account
 - Has suggestions for ingredient substitutions

Metrics

- Usability
 - Number of clicks to achieve desired goals
- Number of platforms the app runs on
- Number of users the applications allows for

AWS API
is pretty easy
for working with
RB

↑ I would
do this
before letting
user create
their own

6 Appendix A References

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